Fits Issues:
How done, who does them

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External fits

In data listings:

- **HFAG:** in B-sections (note + URL details)
- **Tau Michele parameters:** (note)

  LEP EW Group: Z, W couplings (URL)

In reviews:

- **Electroweak Model:** authors fit (GAPP, MINUIT)
- **CKM review:** CKMfitter, Utfit
- **WMAP fits:** cosmology reviews, parameters

Electroweak Model review

10.6. Global fit results

In this section we present the results of global fits to the experimental data discussed in Sec. 10.3–Sec. 10.5. For earlier analyses see Refs. 128 and 213.

Table 10.4: Principal non-Z pole observables, compared with the SM best fit predictions. The first M_W value is from the Tevatron [214] and the second one from LEP 2 [172]. e-DIS [129] and the ν-DIS constraints from CDHS [102], CHARM [103], and CCFR [104] are included, as well, but not shown in the Table. The world averages for $g_{V,A}^{\nu e}$ are dominated by the CHARM II [98] results, $g_V^{\nu e} = -0.035 \pm 0.017$ and $g_A^{\nu e} = -0.503 \pm 0.017$. The errors are the total (experimental plus theoretical) uncertainties. The τ_τ value is the τ lifetime world average computed by combining the direct measurements with values derived from the leptonic branching ratios [54]; in this case, the theory uncertainty is included in the SM prediction. In all other SM predictions, the uncertainty is from M_Z, M_H, m_t, m_b, m_c, $\widehat{\alpha}(M_Z)$, and α_s, and their correlations have been accounted for. The column denoted Pull gives the standard deviations for the principal fit with M_H free, while the column denoted Dev. (Deviation) is for $M_H = 124.5$ GeV [215] fixed.

Quantity	Value	Standard Model	Pull	Dev.
m_t [GeV]	173.4 ± 1.0	173.5 ± 1.0	-0.1	-0.3
M_W [GeV]	80.420 ± 0.031	80.381 ± 0.014	1.2	1.6
	80.376 ± 0.033		-0.2	0.2
$g_V^{\nu e}$	-0.040 ± 0.015	-0.0398 ± 0.0003	0.0	0.0
$g_A^{\nu e}$	-0.507 ± 0.014	-0.5064 ± 0.0001	0.0	0.0
$Q_W(e)$	-0.0403 ± 0.0053	-0.0474 ± 0.0005	1.3	1.3
$Q_W(\mathrm{Cs})$	-73.20 ± 0.35	-73.23 ± 0.02	0.1	0.1
$Q_W(\mathrm{Tl})$	-116.4 ± 3.6	-116.88 ± 0.03	0.1	0.1
τ_τ [fs]	291.13 ± 0.43	290.75 ± 2.51	0.1	0.1
$\frac{1}{2}(g_\mu - 2 - \frac{\alpha}{\pi})$	$(4511.07 \pm 0.77) \times 10^{-9}$	$(4508.70 \pm 0.09) \times 10^{-9}$	3.0	3.0

Authors fit (GAPP, MINUIT);

Details described in the review;

PDG fits (internal)

73 fits:

- **46 BR** (Branching Ratio):

  tau; KL; D+-;
  B0; psi(2S); chi_c012 psi(2S); Lambda_c; ...

- **14 Special:**

  K0mu3 form factors; K_L eta+-,00 phases;
  Sigma+ decay parameters; ...

- **13 Mass:**

  D,D*,D_s,D_s* masses; Xi masses;
  psi masses; ...

PDG fits details

BR fit: Single-particle:

- Each BR parameter > 0; Sum[BR(i)] = 1 constrain;

  prints output correlations and, if possible, decay widths;

  Multi-particle:

- No Sum[BR(i)] constrain;

Special:

- No constraints;
- Can specify relationship between nodes;
- Details often described in minireview;

Mass:

- Customized version of a special fit;

PDG fits: eta BR

CONSTRAINED FIT INFORMATION

An overall fit to a decay rate and 19 branching ratios uses 49 measurements and one constraint to determine 9 parameters. The overall fit has a $\chi^2 = 56.4$ for 41 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\langle \delta x_i \delta x_j \rangle / (\delta x_i \cdot \delta x_j)$, in percent, from the fit to the branching fractions, $x_i \equiv \Gamma_i/\Gamma_{\text{total}}$. The fit constrains the x_i whose labels appear in this array to sum to one.

x_3	26							
x_4	−1	−1						
x_9	−66	−73	−1					
x_{10}	−44	−46	0	12				
x_{11}	−5	−5	0	−6	−3			
x_{12}	0	0	0	−1	0	0		
x_{16}	0	0	0	0	0	0	0	
Γ	−10	−2	0	6	4	1	0	0
	x_2	x_3	x_4	x_9	x_{10}	x_{11}	x_{12}	x_{16}

	Mode	Rate (keV)	Scale factor
Γ_2	2γ	0.510 ±0.026	
Γ_3	$3\pi^0$	0.423 ±0.022	
Γ_4	$\pi^0 2\gamma$	(3.5 ±0.7) × 10^{-4}	
Γ_9	$\pi^+\pi^-\pi^0$	0.295 ±0.016	
Γ_{10}	$\pi^+\pi^-\gamma$	0.060 ±0.004	1.2
Γ_{11}	$e^+e^-\gamma$	0.0089±0.0007	1.1
Γ_{12}	$\mu^+\mu^-\gamma$	(4.0 ±0.6) × 10^{-4}	
Γ_{16}	$\pi^+\pi^- e^+ e^- (\gamma)$	(3.48 ±0.23) × 10^{-4}	

- 49 measurements
- 9 fit parameters
- 56.5/41 chi^2

- Output correlations

- Decay widths

PDG fits: More details

- Allow input correlations between measurements
- May use different measurements for fits and averages;
- Rescaling: yes/no;
- Drop measurements: yes/no;
- Data types:
  - Lifetime;
  - Decay widths;
  - Branching ratios and combinations;

Typical usage of fits

$\Lambda(1520)$ BRANCHING RATIOS

See "Sign conventions for resonance couplings" in the Note on Λ and Σ Resonances.

$\Gamma(N\overline{K})/\Gamma_{total}$ Γ_1/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.45 ±0.01 OUR ESTIMATE				
0.447±0.007 OUR FIT Error includes scale factor of 1.2.				
0.455±0.011 OUR AVERAGE				
0.47 ±0.02	GOPAL	80	DPWA	$\overline{K}N \to \overline{K}N$
0.45 ±0.03	ALSTON-...	78	DPWA	$\overline{K}N \to \overline{K}N$
0.448±0.014	CORDEN	75	DBC	K^- d 1.4–1.8 GeV/c
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.47 ±0.01	GOPAL	77	DPWA	See GOPAL 80
0.42	MAST	76	HBC	$K^-p \to \overline{K}^0 n$

$\Gamma(\Sigma\pi)/\Gamma_{total}$ Γ_2/Γ

VALUE	DOCUMENT ID		TECN	COMMENT
0.42 ±0.01 OUR ESTIMATE				
0.420±0.007 OUR FIT Error includes scale factor of 1.2.				
0.423±0.011 OUR AVERAGE				
0.426±0.014	CORDEN	75	DBC	K^- d 1.4–1.8 GeV/c
0.418±0.017	BARBARO-...	69B	HBC	K^-p 0.28–0.45 GeV/c
• • • We do not use the following data for averages, fits, limits, etc. • • •				
0.46	KIM	71	DPWA	K-matrix analysis

$\Gamma(\Sigma\pi)/\Gamma(N\overline{K})$ Γ_2/Γ_1

VALUE	DOCUMENT ID		TECN	COMMENT
0.940±0.026 OUR FIT Error includes scale factor of 1.3.				
0.95 ±0.04 OUR AVERAGE Error includes scale factor of 1.7. See the ideogram below.				
0.98 ±0.03	[4] GOPAL	77	DPWA	$\overline{K}N$ multichannel
0.82 ±0.08	BURKHARDT	69	HBC	K^-p 0.8–1.2 GeV/c
1.06 ±0.14	SCHEUER	68	DBC	K^-N 3 GeV/c
0.96 ±0.20	DAHL	67	HBC	π^-p 1.6–4 GeV/c
0.73 ±0.11	DAUBER	67	HBC	K^-p 2 GeV/c
• • • We do not use the following data for averages, fits, limits, etc. • • •				

- Measured G1/G, G2/G, G1/G2;
- Fit G1, G2;

Discussion Points:

- Any shortcomings of existing PDG fits

  e.g. other types of fits?

- Is current information about internal, external fits sufficient?

- Need for new collaboration with fitting groups?

- Other comments;